Weapons Release/Fire Workgroup

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Weapons Release Group
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Background

- Approach/methodology
  - Reviewed TLMs/Precepts
  - Selected precepts relevant to Weapons Release/Fire
    - OSP-5, DSP-5, DSP-6, DSP-7, DSP-8, DSP-9
  - Identified hazards with respect to selected precepts
  - Where necessary, proposed additional safety design requirements with respect to hazards
- Identified Issues – Added three new precepts

Weapons Release/Fire OSP-5

- TLM-2: Inadvertent Weapons Release/Firing
- OSP-5: Weapons will be loaded/energized as late as possible in the operational **environment/timeline**
- Suggested Design Safety Requirements – DSP-5 is the appropriate requirement as stated

Weapons Release/Fire OSP-5, Cont'd

- Applicable hazards
  - Weapon firing based on command from incorrect source
  - Inadvertent firing based on erroneous data
  - Inadvertent release resulting from BIT
  - Inadvertent weapon release resulting from training data
  - Inadvertent weapon release resulting from injecting data during maintenance
  - Inadvertent weapon release during power-up after non-normal shutdown
  - Inadvertent weapon release because of low power that randomizes logic
  - Firing at wrong time (extensive delay in firing)
  - Inability to abort/safe or return to safe state
  - Firing based upon old/stale situational awareness data (DSP4)

Weapons Release/Fire DSP-5

- TLM-2: Inadvertent Weapons Release/Firing
- DSP-5: There shall be positive safety design measures to isolate power from weapons or ordnance initiation circuits until intent to initiate
- Suggested Design Safety Requirements – DSP-5 is the appropriate requirement as stated

Weapons Release/Fire DSP-5, Cont'd

- Applicable hazards
  - Weapon firing based on command from incorrect source
  - Inadvertent firing based on erroneous data
  - Inadvertent release resulting from BIT
  - Inadvertent weapon release resulting from training data
  - Inadvertent weapon release resulting from injecting data during maintenance
  - Inadvertent weapon release during power-up after non-normal shutdown
  - Inadvertent weapon release because of low power that randomizes logic
  - Inability to abort/safe or return to safe state
  - Inadequate safe separation at release

Weapons Release/Fire DSP-6

- TLM-4: Self-Damage of Own System from Weapon Fire/Release
- DSP-6: System design shall prevent **release/**firing of weapons into unmanned system structure or other weapons, and minimize hazards to personnel, equipment, and other vehicle weapons from missile exhaust, gun blast, **directed energy**, or ejecta
- Suggested Design Safety Requirements -- DSP-6 is the appropriate requirement as stated
- Recommend DSP-6 be broken into two segments

Weapons Release/Fire DSP-6, Cont'd

- Applicable hazards
  - Inadvertent weapon release resulting from injecting data during maintenance
  - Inadvertent weapon release during power-up after non-normal shutdown
  - Firing into local obstructions or own platform equipment
  - Firing in unintended direction – e.g., positioning is off, sight/gun not coincident
  - Inadequate safe separation at release
  - Release of malfunctioning weapon

Weapons Release/Fire DSP-7

- TLM-2: Inadvertent Weapons Release/Firing
- DSP-7: A unmanned system shall mitigate through design the uncommanded fire/release of weapons or **propagation/radiation** of hazardous **energy**
- Suggested Design Safety Requirements -- DSP-7 is the appropriate requirement as stated

Weapons Release/Fire DSP-7, Cont'd

- Applicable hazards
  - Weapon firing based on command from incorrect source
  - Inadvertent firing based on erroneous data
  - Inadvertent release resulting from BIT
  - Inadvertent weapon release resulting from training data
  - Inadvertent weapon release resulting from injecting data during maintenance
  - Inadvertent weapon release during power-up after non-normal shutdown
  - Inadvertent weapon release because of low power that randomizes logic
  - Firing at wrong time (extensive delay in firing)
  - Inability to abort/safe or return to safe state
  - Firing based upon old/stale situational awareness data (DSP4)
  - Firing at unintended target
  - Release of malfunctioning weapon

Weapons Release/Fire DSP-8

- TLM-2: Inadvertent Weapons Release/Firing
- DSP-8: There shall be positive safety design measures to monitor and protect against hazardous system**(s)** mode combinations**/transitions**
- Suggested Design Safety Requirements –
  - DSP-8 is an appropriate requirement as stated
  - The capability shall be provided to coordinate or identify mode/state status across all platforms in the system or SoS
  - Systems shall transition from one mode/state to another through a defined safe state
- Assume system mode spans subsystems that are in different modes, i.e. radar in training mode, fire control in tactical mode

Weapons Release/Fire DSP-8, Cont'd

- Applicable hazards
  - Weapon firing based on command from incorrect source
  - Inadvertent firing based on erroneous data
  - Inadvertent weapon release resulting from training data
  - Inadvertent weapon release resulting from injecting data during maintenance
  - Inadvertent weapon release during power-up after non-normal shutdown
  - Firing at wrong time (extensive delay in firing)
  - Firing based upon old/stale situational awareness data (DSP4)
  - Firing in unintended direction – e.g., positioning is off, sight/gun not coincident
  - Firing at unintended target

Weapons Release/Fire DSP-9

- TLM-2: Inadvertent Weapons Release/Firing
- DSP-9: There shall be positive safety design measures [**Delete: for an authorized operator**] to abort a weapon **release/**fire sequence or return the system to a **defined** safe state
- Suggested Design Safety Requirements –
  - Provide independent controls/paths for weapons release/fire override capability (abort function)

Weapons Release/Fire DSP-9, Cont'd

- Applicable hazards
  - Weapon firing based on command from incorrect source
  - Inadvertent firing based on erroneous data
  - Inadvertent release resulting from BIT
  - Inadvertent weapon release resulting from training data
  - Inadvertent weapon release resulting from injecting data during maintenance
  - Inadvertent weapon release during power-up after non-normal shutdown
  - Inadvertent weapon release because of low power that randomizes logic
  - Inability to abort/safe or return to safe state
  - Release of malfunctioning weapon

Proposed DSPs

- There shall be a means of positively identifying the weapon being released/fired
- For non-autonomous systems, there shall be measures to safe an armed weapon when communications are lost
- There shall be measures to cease firing/safe a weapon during the engagement upon certain conditions to be defined

Issue Description
Issue #WR-1

- Rationale for Selecting Issue
  - No applicable precept: recommend new precept
- Issue Description
  - Potential Hazard Source: Inadvertent fire or release of a wrong weapon type.
- Applicable TLM/Precepts
  - TLM-2 (Inadvertent firing/release)

Issue Resolution
Issue # WR-1

- Recommended Issue Resolution
  - New Precept: There shall be a means of positively identifying the weapon being released/fired
- Rationale
  - New Precept: Impacts weight & balance, could impact collateral damage, proper match of weapon type, situational awareness; system dependent

Issue Description
Issue #WR-2

- Rationale for Selecting Issue
  - No applicable precept: recommend new precept
- Issue Description
  - Potential Hazard Source: potential for increased risk of inadvertent firing of weapon if safeties are removed during a firing sequence and the system remains in the armed condition for extended periods of time.
- Applicable TLM/Precepts
  - TLM-2 (Inadvertent firing/release)

Issue Resolution
Issue # WR-2

- Recommended Issue Resolution
  - New Precept: For non-autonomous systems, there shall be measures to safe an armed weapon when communications are lost
- Rationale
  - New Precept: Will be system dependent, but necessary to eliminate unwarranted risk with associated armed weapon

Issue Description
Issue #WR-3

- Rationale for Selecting Issue
  - No applicable precept: recommend new precept
- Issue Description
  - Potential Hazard Source: Single point failures of arming and/or firing circuits results in uncommanded firing.
- Applicable TLM/Precepts
  - TLM-2 (Inadvertent firing/release)

Issue Resolution

Issue # WR-3

- Recommended Issue Resolution
  - New Precept: Weapon release shall require two independent actions each enabled by independent control paths within the release or firing platform.
- Rationale
  - New Precept: Prevent single point failures resulting in inadvertent release/fire of weapon

Summary

- Evaluated and validated existing operational and design precepts; found six relevant to weapons release/fire
- Expanded design safety requirements on two of the existing design precepts
- Identified three potential new design precepts